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OATS AS GRAIN AND FODDER.

This Bulletin contains the results of analyses of Maine grown oats, oat hay cut at different stages of growth, oat and pea hay and silage, and oat feed, together with the results of digestion experiments with these food materials.

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OATS AS GRAIN AND FODDER.

J. M. BARTLETT.

The oat crop ranks third in importance among American cereals in the United States and has a long lead as first in the State of Maine. In 1899 the State grew about 141,600 acres, which was six times as much land as was devoted to any other cereal, and about 5,000,000 bushels of the grain were raised. Owing to the low price and uncertain yield of wheat in recent years, the acreage devoted to oats has greatly increased.

Formerly the oat grain was only used as food for animals but now it holds a prominent place among nutrients for man. The grain varies quite widely in composition and weight. In the southern portions of our country it is much coarser, contains more hull, and is consequently more bulky, a measured bushel weighing sometimes as little as twenty pounds, while the northern grown grain frequently weighs over forty pounds. The quality and composition is also considerably affected by climatic conditions, such as moisture, heat and cold, etc.

The oat plant succeeds best in a cool, moist climate such as is found in northern and eastern Maine, the Provinces, and Prince Edward's Island. It will grow on most all kinds of soil, from light gravelly loam to stiff clays and peats. The oat is a great forager and will grow on poorer soil than wheat or barley. It thrives best and matures the plumpest grain on rather light soil well supplied with moisture, and sufficiently early to allow the oats to be sown the last of April or first of May. Late sown oats are liable to rust before the grain matures.

INFLUENCE OF MANURE ON OATS.

Although oats will grow and yield moderate crops on poorer soils than most other cereals, they respond readily and profitably to liberal applications of manure. Too heavy applications of stable manures or nitrogenous fertilizers are liable to cause an excessive growth of straw at the expense of the grain. Oats require less nitrogen than wheat, and are greatly benefitted by liberal quantities of phosphoric acid, and this fact should be borne in mind in preparing land for them. If stable manure is employed, only a light coat should be added and then a supplementary dressing of acid phosphate applied. In using commercial manures alone, it is always best to use a complete manure unless the land has previously been well supplied with nitrogen from stable manures or some leguminous crop like clover or peas turned under, in which case, only phosphoric acid and potash need be applied with perhaps a little nitrate of soda to furnish soluble nitrogen to start the plants early. For a complete fertilizer it is recommended to use one carrying about 2.5% nitrogen, 8% available phosphoric acid, and 3% potash. A part of the nitrogen, at least .5%, should be in a soluble form as in nitrate of soda, and the remainder in some more insoluble form as tankage, ground fish or bone, in order that the young plant may be made vigorous and thrifty by the former, while the older plant can be kept growing by the latter. This recommendation is based upon results of a large number of experiments by Stoeckhardt which were repeated for several years. He found that when soluble nitrogen was lacking the crop did not prosper in the early stages of vegetation, and also when only soluble nitrogen compounds were used the growth fell off too soon after the plant had flowered. The experiments of both Stoeckhardt and Wolff show that a liberal supply of phosphoric acid is necessary to insure an abundance of plump, well-formed grain. Finely ground bone meal with small amounts of nitrate of soda and muriate of potash are recommended as a fertilizer for this crop.

OATS AS GRAIN.

Oats are a valuable feed for most all farm animals. The relatively large amount of fiber they contain in proportion to kernel, as compared with most other grains, makes them a safer feed with but little danger of over feeding, when put in the hands of careless workmen. They contain a higher proportion of digestible protein than corn or wheat and are lower in carbohydrate materials, consequently the nutritive ratio of the grain is such that it contains in itself a quite well-balanced ration for working animals. They are a very convenient and highly prized grain for feeding horses. They usually are and should be fed unground to horses, unless the animal is unable to masticate his food properly. Experience shows that oats give a horse "mettle," or stimulate him as no other of our grains do. They are consequently held without a peer by horsemen as feed for driving horses and may be made almost exclusively their diet.

A chemist by the name of Sanson claims to have discovered a stimulating principle, supposed to be an alkaloid, in the seed coats of the oat grains, varying in quantity in different varieties of oats and also with soil and climate in which they are grown, but later careful investigations by chemists have failed to discover any alkaloid, or nitrogenous compound of a stimulating nature. Nevertheless the belief is so prevalent among practical feeders that nothing gives so much "mettle" to the horse as oats, it seems evident that they must contain something which, if not a stimulant, acts much like one and makes oats admirably adapted by their nature to this class of animals. For growing colts or dairy stock there is no question but that other grains or combinations such as wheat bran, middlings, linseed, gluten meals, etc., are more economical at present prices, and just as efficient.

Many experiments have been made to test the practicability of using substitutes for oats as feed for horses. At Hohenheim, Germany, in 1893-94 feeding experiments were conducted in which beans and corn were substituted quite largely for oats, the proportions being two pounds oats, three pounds field beans, eight pounds corn. In Paris also the Paris Omnibus Company substituted beans, corn and oil cake for a large portion of the oats in the grain ration, with good results. The New Jersey Experiment Station made an experiment with street car horses in which dried brewers' grains were substituted for oats. The horses fed the grains, performed their work and kept in as good condition as those fed oats. The conclusions of the station authorities were: "That dried brewers' grains, pound for pound, were quite equal to oats in a ration for work horses. The results of the substitution was a saving of about five cents a day for each animal.

The North Dakota Station compared wheat bran and shorts with oats for feeding horses and mules at quite severe work. The conclusions drawn from the experiment were: That the mixture of shorts (middlings) and bran proved of equal worth to oats for the working animals.

The Maine Experiment Station in 1890-91 compared a mixture consisting of twelve parts wheat middlings, seven parts gluten meal, three parts linseed meal, with oats as a grain ration for growing colts. The results of the two tests show that the mixed grain ration produced more rapid growth at less cost than the oat ration.

The above experiments show that other grains can be often profitably substituted for oats at present prices in rations for horses without detriment to the animal and a financial saving to the owner.

MAINE GROWN OATS.

In 1898 the writer, in estimating the food value of our different grains, had occasion to look up the composition of Maine oats and found that very few analyses of well authenticated Maine grown grain had been made, and as the composition of oats grown in different climates varies quite widely, the average analysis given for the whole country would not furnish very reliable data. Therefore it was considered advisable to collect samples of Maine grown oats from different parts of the State for analyses. The work was begun so late in 1898 that very few samples, five only, were obtained and very little data was given with them. Early in 1899 a circular was sent out to several parties in different parts of the State requesting samples and information as to methods of tillage, manuring, etc. Eleven samples were received from localities which represented nearly all the oat growing regions of the State.

The tables which follow give the data furnished by the growers of the oats as to previous treatment of the soil, its preparation for the crop, the dates of sowing and harvesting and the yield per acre. The weights of straws are largely estimates and therefore cannot be considered very accurate. The bushels are probably measured bushels and consequently would over run in the case of the heavy oats. The weights per bushel were estimated in the laboratory.

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The table on page 15 gives the chemical composition of the grain calculated to water content at time of receipt and also as calculated to a water-free basis.

ANALYSIS OF MAINE GROWN OATS. FROM WHOM OBTAINED, WHERE THEY WERE GROWN, THE KIND OF SOIL, AND KINDS OF CROPS GROWN ON THE LAND IN PRECEDING YEARS.

Station number of sample.	Furnished by.	Town Where Raised.	Kind of Soil.	Crops Raised on Land in	
				1897.	1898.
4142	Ansel Briggs	North Auburn	Rocky loam	Corn.	
4143	J. Benn	Hodgdon.			
4144	J. M. Winslow	Nobleboro.			
4145	O. B. & E. S. Poor	Andover	Clay loam	Hay	Oats.
4146	W. G. Hunton	Readfield		Hay	Oats.
4187	A. T. Griffin	Lincoln Center	Sandy loam		Corn and beans.
4188	J. M. Winslow	Nobleboro	Coarse rocky loam	Hay	Corn.
4189	C. A. Brown	Lincoln	Light clay loam	Hay	Potatoes, oats and corn.
4190	E. M. Gerald	Clinton	Light clay loam	Hay	Hay.
4195	Y. W. Skelton	Bowdoin	Light clay and sand	Hay	Potatoes, corn and oats.
4197	Lewis C. Kimball	Hermon	Gravelly	Potatoes and corn	Potatoes and beans.
4198	G. W. Patten	West Pittsfield	Rocky poor loam	Hay	Hay.
4200	Lorimer McGlauflin	Charlotte	Light loam	Oats	Potatoes.
4201	Henry S. Balentine	Topsham	Medium clay loam	Hay	Corn and potatoes.
4206	Oscar Shirley	Houlton	Light clay loam	Hay	Potatoes.
4207	E. B. Owen	West Pembroke	Light clay loam	Oats, barley and potatoes	Oats, barley and potatoes.

ANALYSIS OF MAINE GROWN OATS, MANURING, VARIETY, DATES OF PLANTING AND HARVESTING AND YIELDS PER ACRE

Station Number of Sample.	How Manured in 1898.	How Manured in 1899.	Seed.	Date of Sowing.	Date of Harvesting.	Yield of Grain per Acre—Bushels.	Yield of Straw per Acre—Tons.
4142	Light coat of manure	....	....	....	....	39½	....
4143	....	....	....	....	....	....	....
4144	....	....	....	....	....	....	....
4145	12 cords manure to acre	....	....	....	....	50	....
4146	Light coat of manure	....	....	....	....	36	....
4187	Yard manure and fertilizer	500 pounds to acre Bradley's Eureka	....	May 15.	Sept. 1	46	2¾
4188	300 pounds fertilizer and 8 cords stable manure	None	....	May 8.	Aug. 1	42	3
4189	4 cords manure, 500 lbs. cheap fertilizer	Six cords manure	Scottish Chief	May 1.	Aug. 16	55	1½
4190	None	600 pounds Packer's Union Fertilizer	Liberty	....	Aug. 22	50	1¼
4195	Seven cords manure per acre	Six cords manure, 800 lbs. Crocker's Potato to acre	Western	May 10.	Aug. 23	59	1½
4197	Stable manure	Six cords stable manure to acre	Common	April 20.	Aug. 7	50	2
4198	None	500 pounds to acre Great Eastern	White Russian	May 15.	Aug. 15	46	1½
4200	Barn manure and Bradley Fertilizer	None	Parker Oats	May 10.	Aug. 17	60	2½
4201	Twenty loads stable manure per acre	Six cords stable manure	Common Western	May 11.	Aug. 14	50	2
4206	None	Fifteen tons barn manure	Siberian	May 1.	Sept. 5-10	56	2
4207	Fish pomace and barn manure	Four cords manure, 1000 pounds fish	Hogan	April 20.	Sept. 10	55	1

ANALYSES OF MAINE GROWN OATS. COMPOSITION OF THE OATS ON CURED AND WATER FREE BASIS.

Variety.	Station number.	Weight per bushel.	Water.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.	Calories per gram.
On Cured Basis.		lbs.	%	%	%	%	%	%	
	4142	.....	8.39	3.03	10.63	13.92	59.27	4.76	4.247
	4143	......	8.66	3.59	11.69	13.47	57.88	4.71	4.215
	4144	......	8.73	3.01	13.00	12.13	58.20	4.93	4.270
	4145	.....	11.15	2.92	12.56	11.28	57.70	4.39	4.161
	4146	....	8.07	3.41	12.13	13.24	58.26	4.89	4.218
	4187	34	11.35	3.95	10.75	9.33	61.27	3.35	4.203
	4188	34	10.20	3.67	11.13	9.13	60.23	5.64	4.300
Scottish Chief	4189	33½	10.23	3.19	10.88	8.31	62.17	5.22	4.250
Liberty	4190	31½	10.18	3.43	11.38	9.19	60.28	5.54	4 232
Weston	4195	34½	10.92	3.08	11.25	8.64	60.25	5.86	4.285
Common	4197	35	9.84	3.42	9.93	10.29	61.13	5.39	4.258
White Russian	4198	34½	9.21	3.14	12.75	10.10	58.36	6.44	4.376
Parker Oats	4200	41½	11.69	2.91	11.56	10.62	57.29	5.93	4.294
Common Western	4201	32½	9.09	3.91	12.57	11.71	56.08	6.64	
Siberian	4206	37	11.16	2.85	12.12	9.18	59.03	5.66	
Hogan	4207	41	9.46	2.84	11.50	11.03	60.13	5.04	4.291
On Water Free Basis.									
	4142	.....	....	3.31	11.60	15.20	64.70	5.19	4.636
	4143	.....	....	3.93	12.80	14.71	63.40	5.16	4.614
	4144	.....	....	3.30	14.20	13.30	63.80	5.40	4.607
	4145	.....	......	3.28	14.09	12.70	64.99	4.90	4.683
	4146	.....	....	3.71	13.19	14.39	63.39	5.32	4.588
	4187	.....	....	4.46	12.13	10.52	69.11	3.78	4.741
	4188	.....	....	4.09	12.39	10.17	67 07	6.28	4.788
Scottish Chief	4189	.....	....	3.55	12.12	9.26	69.26	5.81	4.734
Liberty	4190	.....	....	3.82	12.67	10.23	67.11	6.17	4.712
Weston	4195	.....	....	3.46	12.63	9.70	67.63	6.58	4.810
Common	4197	.....	......	3.79	11.01	11.41	67.81	5.98	4.723
White Russian	4198	.....	....	3.46	14.04	11.12	64.29	7.09	4.820
Parker Oats	4200	.....	....	3.30	13.09	12.03	64.87	6.71	4.862
Common Western	4201	.....	....	4.30	13.83	12.88	61.69	7.30	
Siberian	4206	.....	....	3.21	13.64	10.33	66.45	6.37	
Hogan	4207	.....	....	3.14	12.70	12.18	66.42	5.56	4.739

In the above table, where the weight per bushel of most of other samples are given, it will be noticed that contrary to the common belief the light oats show about as good chemical composition as the heavy ones. Therefore the food value of a bushel (32 pounds) of light oats is about the same as 32 pounds of heavy oats, and it seems to matter little whether oats weigh 32 or 40 pounds to the measured bushel if they are bought and fed by weight. Probably exceedingly light oats like those grown in the south, weighing much under 30 pounds, would contain a larger proportion of crude fiber and consequently less nutritive value; therefore the above statement as to feed value would only be true as regards northern grown, or the heavier oats, weighing over 30 pounds to the measured bushel.

OATS AS HAY.

It is quite a common practice with many farmers to harvest oats before the grain is mature and cure them for coarse fodder. This is a very desirable plan to follow at times when the hay crop is short, or in localities where the land is badly infested with noxious weeds like the Canada thistle or wild mustard, both of which should be cut before they seed.

The oat plant, however, is not an ideal one for making hay. The stalks are hollow, coarse and hard, and unless dried very quickly in a bright sun they become bleached, even when cut green, so that they look little better than straw. To cure the crop in its best condition and retain its bright green color and palatability, it should be dried in a bright sun for a few hours, with liberal use of the hay tedder when there is a heavy growth; then raked together and the curing completed in the windrow or cock, with as little exposure to moisture as possible. If the weather is unfavorable, as is frequently the case during the latter part of July or first of August when oats are mature enough to cut for hay, they are very liable to be seriously injured and rendered unpalatable.

Oats, however, when not sown too thickly, have an advantage over other plants, which make more desirable hay, of being a fairly good catch crop for seeding to grass, as they mature early enough to allow the young grass to get a good start in the fall, and for this reason are desirable on the farm.

It is quite well known, and there is considerable experimental data showing that most plants like the grasses, clovers, etc., usually grown for hay are at their best to harvest when in bloom, but as regards oats there is very little available information indicating at what stage of growth they should be cut for hay making. Accordingly some experiments were undertaken to determine the comparative value of oat hay cut at different stages of maturity. In 1897 a section of a field of oats was set apart for these tests. The portion selected was covered with a fairly uniform growth and the oats in all parts of it appeared at about the same stage of maturity. The piece was then divided into three equal sections. One of these sections was cut on July 27th when the oats were in bloom. A second section was cut one week later, August 5th, when nearly all the kernels were in the milk stage, and the third August 12th when nearly all the grains had passed to the dough stage of maturity, the tops and upper portion of the stalks were green, but the lower portions showed signs of ripening. When cured this cutting made nearly as good looking hay as the other two sections, but evidently was not as palatable as it was not as readily eaten by the sheep. Care was taken in curing all the cuttings to avoid exposure to moisture, all were dried as quickly as possible and then stored in the barn until needed for further work.

To estimate the increased yield from the growth of the crop during the time that elapsed between the cuttings, three sections, each 10 x 15 feet, were taken in different parts of the large plats. One third, five feet of the length, was cut each time that cuttings were made from the larger sections, carefully dried and the dry matter determined in each, which is given in pounds per acre.

Dry matter of 1st cutting per acre, 4418.8 pounds.
Dry matter of 2d cutting per acre, 5218.3 pounds.
Dry matter of 3d cutting per acre, 4571.0 pounds.

The composition of the hays cut at different stages of maturity is shown in the tables on pages 21 and 22.

The composition of three different sections of the oat plant is also given in the same tables. These studies were made in order to determine at what distance from the ground the oats should be cut, as well as what loss occurs by leaving a long stubble. Some plants 3½ to 4 feet high were cut close to the ground and then divided into three sections, one of which was the first eight inches of the lower part of the stalk, another the second eight inches, and the third, the remainder of the plant or top. An inspection of the tables shows a marked difference in composition of the different sections. The bottom section has very little food value, containing only 2.77% protein and 1.90% fat, both of which are probably not more than 40% digestible. The second section has only about half the protein of the top section and its digestibility is probably less. It would, therefore, be advisable to leave a high stubble, not less than 8 to 10 inches of plants 3 to 4 feet high in harvesting, and the loss incurred by leaving the coarser part of the stalks on the ground will be more than compensated by the improved quality and palatability of the hay.

OATS AS SILAGE.

Oats will make a very fair quality of silage when properly put in the silo, but the plant from the nature of its structure is not well adapted to the process of ensiling. The stalks being hollow carry, when not crushed or broken, a large amount of air into the mass which prolongs fermentation to the detriment of the quality of the silage. It therefore is necessary to run such materials through the silage cutter to obtain the best results. Although the plant is not an ideal one for the purpose, it is often desirable to put a field of oats into the silo on account of the presence of noxious weeds, rust, bad weather for drying at time of harvesting, or for other reasons. The station farm silos have several times been filled with this material. To avoid expense, the oats were at first put into the silo without cutting them in the silage cutter. All usual precautions of packing well at the sides and corners were observed in filling, and after full the silos were well covered, and weighted. In storing by this method, much of the silage spoiled and the remainder was not first quality. Subsequently the silos were filled several times with oats and peas run through the silage cutter, and the materials kept perfectly, coming out in green, nice condition and were as well relished by cattle as corn silage.

OAT AND PEA HAY.

Oats and peas grown together and harvested when the oats are in the early milk stage make a forage crop very much superior to oats alone for either hay, soiling, or silage. As peas are a leguminous plant they increase the protein of the fodder, and also improve the soil by leaving behind, in their roots and stubble, a part of the nitrogen which they take from the air. By growing the mixture then, both the fodder and the soil are improved, whereas if oats are grown alone a rather poor fodder is obtained and the soil reduced in fertility. This combination makes one of the best soiling crops for feed in July and August before corn or Hungarian is mature enough to cut. If the crop is allowed to mature and the two grains are ground together, the result is a most excellent feed for dairy cows and is much used by Canadian farmers. The chief objection to the material for making hay is that it dries rather slowly. The pea vines are like clover in this respect and should be cured in much the same manner, in the windrow or cock. When well cured without too much exposure to moisture and sun it makes a fodder fully equal to our best English hay. In case of bad weather the silo can be resorted to as a means of caring for the crop. but the material should be run through a silage cutter before ensiling, otherwise it is liable to be poorly preserved. In sections of the State where corn cannot be grown on account of frosts, peas and oats make a valuable substitute with which to fill the silo. For composition and digestibility of oat and pea silage see pages 21-23.

The amount of seed to apply depends somewhat on the condition of the land and whether it is to be seeded to grass. The usual amounts sown are 1½ bushels oats and 1½ bushels peas to the acre, but several plots were grown on the Station farm with good success on fairly good soil, with a seeding of one bushel oats and two bushels peas to the acre. Three different varieties of peas were used and the yields of cured hay are given below.

Oat and Canada blue pea hay, 5,440 pounds to an acre.
Oat and Canada white pea hay, 5,408 pounds to an acre.
Oat and Mummy pea hay, 5,952 pounds to an acre.
For composition and digestibility see pages 21-23.

BY-PRODUCTS OF THE OAT.

In the manufacture of oat products for human food, the kernel of the oat is separated from the hull. Oat hulls are in themselves, low in food value, being worth but little more than the same weight of oat straw. Their value may be materially greater if broken kernels or small oats are ground in with them. Manufacturers of oat products are putting ground oat hulls on the market in many forms and mixtures, such as oat feed, oat chop, corn and oat feed, chop, etc. The bulk of all these materials is ground oat hulls, with admixtures of oat kernels, ground corn, etc. The feeding value of them is variable, and they should never be bought except on a guaranteed composition, and then it should be remembered that the oat hulls are not as digestible as the kernel of oats or other grains. Unscrupulous dealers frequently sell "oat feeds" as ground oats, the unsuspecting buyer thinking he is getting the whole oat meal, which is much more valuable than most oat feeds.

Very few farmers can afford to buy feeds low in protein and high in carbohydrates at any price at which they have been or are likely to be offered. The farmer should grow all the coarse feeds that he needs. Oat and similar feeds are very much like corn stalks or oat straw in composition. Some of the feeds have cottonseed or other nitrogenous feeding stuffs added to them so that they carry more protein than straight oat feeds, but these mixtures are always more expensive sources of protein than are the glutens, cottonseed and linseed meals. One hundred pounds of an ordinary oat feed has from eight to eleven pounds protein. At seventy-five cents per hundred the protein costs from seven to nine cents a pound. One hundred pounds of a good gluten meal has from thirty-four to forty per cent of protein. At $1.30 per hundred the protein costs about three cents a pound and it not only costs less than half as much as that of the oat feed but it is better digested.

The tables which follow give the analyses of oat hays cut at different stages of growth, of different parts of the oat plant, of oat and pea and oat and vetch hays, and oats and oat products used in digestion experiments from which the digestion coefficients in the table on page 23 were obtained.

ANALYSES OF OAT PRODUCTS CALCULATED TO WATER CONTENT AT TIME OF SAMPLING.

Kind of Material.	Station number.	Water.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Oat hay, cut when in bloom...	*4097	16.00	77.66	6.34	8.28	30.85	36.44	2.11
Oat hay, cut when grain was in milk	*4096	16.00	78.67	5.23	8.89	26.49	40.66	2.73
Oat hay, cut when grain was in dough	*4089	16.30	78.49	5.21	6.47	26.58	42.60	2.84
Oat hay, cut when part of heads were in bloom, part in milk.	*4127	13.76	79.91	6.33	8.80	28.87	39.38	2.86
Oat hay, cut when part of heads were in milk, part in dough.	*4130	13.28	80.47	6.25	6.59	29.45	41.13	3.30
Oat hay, first 8 inch section of bottom of stalk...	4134	9.80	84.03	6.17	2.50	39.23	40.58	1.72
Oat hay, second 8 inch section of stalk......................	4135	10.00	82.65	7.35	4.31	37.43	38.91	2.00
Oat hay, top of plant..........	4133	11.33	82.45	6.22	8.53	24.68	45.88	3.36
Oat and pea hay.......	*4174	14.50	77.51	7.99	14.41	26.84	33.69	2.57
Oat and pea silage.	*4202	73.80	24.15	2.05	3.34	8.75	10.45	1.61
Oat and vetch hay.............	*4217	20.00	73.93	6.07	8.51	24.93	37.68	2.81
Oat and pea hay	*4222	25.08	68.99	5.93	10.31	25.01	31.45	2.22
Oats.	*4145	11.15	85 93	2.92	12.56	11.28	57.70	4.39
Oats	*4234	13.16	83.69	3.15	11.38	10.31	57.06	4.94
Royal Oat Feed	*4245	10.37	83.90	5.73	6.69	22.39	51.74	3.08
Oat straw.	27	10.00	86.33	3.67	3.56	37.80	42.00	3.00
Oat and Canada blue pea hay.	4184	14.84	78.91	6.25	9.78	25.42	40.90	2.81
Oat and Canada white pea hay	4185	16.00	78.12	5.88	10.58	24.60	39.97	2.97
Oat and mummy pea hay......	4186	14.83	79.70	5.47	9.21	25.72	41.86	2.91
Oat and spring vetch hay......	4183	11.53	82.27	6.20	9.14	27.28	43.12	2.73

* The materials from which these samples were taken were used in the experiments from which the digestion coefficients in the table on page 23 were obtained.

ANALYSES OF OAT PRODUCTS CALCULATED TO DRY MATTER (WATER-FREE SUBSTANCE).

Kind of Material.	Station number.	Dry matter.	Water-Free.					
			Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%	%	%
Oat hay, cut when in bloom..	*4097	73.54	92.45	7.55	9.86	36.70	43.38	2.51
Oat hay, cut when grain was in milk	*4096	73.41	93.77	6.23	10.58	31.53	48.41	3.25
Oat hay, cut when grain was in dough.........................	*4089	83.70	93.77	6.23	7.73	31.74	50.91	3.39
Oat hay, cut when part of heads were in bloom, part in milk	*4127	86.24	92.66	7.34	10.20	33.48	45.66	3.32
Oat hay, cut when part of heads were in milk, part in dough.	*4130	86.72	92.79	7.21	7.60	33.96	47.42	3.81
Oat hay, first 8-inch section of bottom of stalk	4134	90.20	93.16	6.84	2.77	43.49	45.00	1.90
Oat hay, second 8-inch section of stalk......................	4135	90.00	91.84	8.16	4.79	41.60	43.23	2.22
Oat hay, top of plant..........	4133	88.67	92.99	7.01	9.62	27.83	51.75	3.79
Oat and pea hay	*4174	85.50	90.65	9.35	16.85	31.39	39.41	3.00
Oat and pea silage............	*4202	26.20	92.17	7.83	12.74	33.40	39.90	6.13
Oat and vetch hay............	*4217	80.00	92.41	7.59	10.64	31.16	47.10	3.51
Oat and pea hay...............	*4222	74.92	92.09	7.91	13.76	33.38	41.99	2.96
Oats.	*4145	88.85	96.72	3.28	14.09	12.70	64.99	4.94
Oats..............	*4234	86.84	96.37	3.63	13.10	11.87	65.71	5.69
Royal Oat Feed	4245	89.63	93.61	6.39	7.46	24.98	57.73	3.44
Oat straw	27	90.60	95.92	4.08	3.95	42.00	46.67	3.30
Oat and Canada blue pea hay.	4184	85.16	92.66	7.34	11.48	29.85	48.03	3.30
Oat and Canada white pea hay	4185	84.00	93.00	7.00	12.60	29.28	47.59	3.53
Oat and mummy pea hay.....	4186	85.17	93.58	6.42	10.81	30.20	49.15	3.42
Oat and spring vetch hay.....	4183	88.47	81.46	7.01	10.33	30.83	48.74	3.09

*The materials from which these samples were taken were used in the experiments from which the digestion coefficients in the table on page 23 were obtained.

THE DIGESTIBILITY OF OAT PRODUCTS.

In additional to the chemical study of oats and oat products reported in the preceding tables, digestion experiments with sheep were made with the food materials the laboratory numbers of which are marked with the asterisk. The full data of these digestion experiments have been printed in previous publications of the Station. The final results of the coefficients thus obtained are given in the table which follows:

DIGESTION COEFFICIENTS OBTAINED FOR OAT PRODUCTS.

	Station number.	Dry matter.	Organic matter.	Ash.	Protein.	Crude fiber.	Nitrogen-free extract.	Fat.
		%	%	%	%	%	%	%
Oat hay, cut when in bloom...	4097	54.3	53.7	48.6	53.5	59.9	51.2	48.3
Oat hay, cut when grain was in milk........................	4096	52.8	54.0	34.1	58.6	50.3	55.0	62.3
Oat hay, cut when grain was in dough	4089	53.8	54.8	41.0	44.7	49.4	59.1	64.5
Oat hay, cut when part of heads were in bloom, part in milk...................	4127	55.9	57.3	37.7	63.6	54.5	57.5	63.3
Oat hay, cut when part of heads were in milk, part in dough	4130	55.2	56.6	38.2	47.6	52.5	59.7	71.6
Oat and pea hay	4174	64.2	62.5	58.2	72.2	63.0	63.7	54.4
Oat and pea silage	4202	65.5	66.6	52.4	74.6	61.3	67.0	75.0
Oat and vetch hay	4217	60.1	60.2	60.2	69.5	51.5	62.7	73.8
Oat and pea hay..	4222	58.5	58.5	59.1	74.7	51.8	57.6	64.8
Oats	4145	69.2	71.3	......	75.5	30.8	77.2	
Oats	4234	71.5	72.5	44.5	78.9	31.2	77.3	89 3
Royal Oat Feed................	4245	47.3	48.1	37.4	69.1	33.1	50.9	88.2

DIGESTIBLE NUTRIENTS IN DRY MATTER OF OAT PRODUCTS.

In order to compare the feeding values of different food materials, the digestible rather than the total nutrients must be taken into account. This is done in the following table which shows the percentage of digestible nutrients in the different oat products here reported upon.

The results of the experiments indicate that the nutrients of oat hay are in the most digestible form when the heads are in milk. If cut in bloom there is a less yield of poorer composition and digestibility than when cut in milk. If the cutting is delayed till the oats are in the dough stage, the slightly larger yield is more than offset by the poor quality and lessened digestibility of the hay.

	Dry matter.	Organic matter.	Ash.	Protein.	Fiber.	Nitrogen-free extract.	Fat.
Oat hay, in bloom	45.6	41.7	3.10	4.43	18.48	18.66	1.02
Oat hay, in milk	44.4	42.5	1.78	5.21	13.33	22.39	1.70
Oat hay, in dough	45.0	43.0	2.14	2.89	13.14	25.18	1.83
Oat hay, bloom and milk	48.2	45.8	2.39	4.80	15.75	22.66	1.80
Oat hay, milk and dough	47.9	45.6	2.39	3.14	15.49	24.54	2.36
Oat and pea hay	49.4	43.8	4.08	9.04	14.92	19.75	1.42
Oat and pea silage	17.2	16.1	1.07	2.49	5.36	6.67	1.21
Oat and vetch hay	48.1	44.4	3.65	5.61	12.82	23.64	2.06
Oats	62.1	60.7	1.40	8.99	3.21	44.14	4.41
Royal Oat Feed	42.6	40.4	2.14	4.63	7.41	26.34	2.72

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